REMARKS

Favorable consideration and allowance of the present application are respectfully requested in view of the foregoing amendments and the following remarks.

Currently, claims 1-2, 4-13, 42, and 44-63 are pending in the present application, including independent claims 1, 46, and 48-50.

Independent claim 1, for example, is directed to a method for heat treating a semiconductor wafer. The wafer is placed in a thermal processing chamber that is in communication with a plurality of lamps, and the wafer defines a plurality of localized regions along a radial axis. The temperature of the semiconductor wafer is adjusted to a predetermined temperature according to a predetermined heat cycle, and this heat cycle includes a heating stage during which the semiconductor wafer is heated by the plurality of lamps. During at least one stage of the heat cycle, a gas is provided to selectively control the temperature of at least one of the localized regions of the semiconductor wafer, which minimizes temperature deviation of the localized region(s) from the predetermined temperature.

Various advantages and benefits are achieved through this method. For instance, the temperature profile of the semiconductor wafer can be maintained at a substantially uniform temperature throughout the entire predetermined heating cycle, which may include ramp-up, steady state, and ramp-down stages. Moreover, by maintaining the temperature profile of the wafer at substantially uniform temperatures, the resulting method can be used, for example, to effectively anneal a silicon wafer and/or thin films or layers formed thereon, as well as to form ultra-thin coatings and films on the wafer.

Claims 1, 2, 5, 8-11, 42, 44-45, and 48, which include independent claims 1 and 48, were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,238,588 B1 to Collins, et al. The Office Action states that Collins, et al. expressly and impliedly teaches the claimed method for heat treating a semiconductor wafer, citing Figs. 17A and 17B as well as various portions of the specification of Collins, et al.

Applicants respectfully submit, however, that independent claims 1 and 48 are not anticipated by the disclosure of Collins, et al. Collins, et al. is directed to an etching

process for a semiconductor workpiece where the process is carried out under high pressure and in the presence of a high concentration of non-reactive diluent gas. The etching process of Collins, et al. involves increasing the chamber pressure of a high ion density RF plasma reactor by introducing a non-reactive gas (such as an inert gas) rather than by throttling back the chamber vacuum pump. (Col. 3, lines 28-34). Collins, et al. states that its etching process allows for the etchant and the polymer precursor gas (such as a fluorocarbon or fluoro-hydrocarbon gas) to be diluted with an inert gas (such as argon) to increase chamber pressure without a corresponding significant change in the chamber vacuum pump rate. (Col. 3, lines 34-39).

At pages 2-3, the Office Action states that the gas provided through gas injection heads 64a, 64b, 64c, and 64d, (shown, for example, in Figs. 17A and 17B of Collins, et al.) is provided to selectively control the temperature of at least one localized region of the semiconductor wafer. Collins, et al. explains that gas feeds 64a-64d furnish the process gas into chamber 40. By controlling the flow rates of the process gas through gas feeds 64a-64d toward the workpiece center and the workpiece periphery, etch rates at the workpiece center and at the workpiece periphery can be adjusted independently relative to one another to achieve a more radially uniform etch rate distribution across the semiconductor workpiece. (Col. 8, lines 36-59). Likewise, Collins, et al. describes how etch performance at the workpiece center and edges may be controlled by adjusting the gas flow rate through center gas feed 64a and outer gas feeds 64b-64d. (Col. 11, lines 42-49).

However, nowhere in Collins, et al. is it disclosed that gas feeds 64a-64d act to provide a gas that selectively controls the temperature of any region(s) of the semiconductor workpiece to minimize temperature deviation of the localized region(s) from a predetermined temperature. The portion of column 14 of Collins, et al. cited in the Office Action refers only to separately controlling the gas flow rates through the individual gas feeds (for example, feeds 64a-64d) to achieve uniformity of plasma process parameters, such as ion density, ion energy, etch rate, and etch selectivity. Again, Collins, et al. does not disclose features of independent claims 1 and 48, including, for example, the providing of a gas to selectively control the temperature of

localized region(s) of a semiconductor wafer to minimize temperature deviation of the region(s) from a predetermined temperature.

In fact, Collins, et al. only mentions "temperature control" in conjunction with either the *ceiling* of the high ion density RF plasma reactor or the *disposable silicon ring* 62 and does not disclose using a gas to selectively control the temperature of localized region(s) of a semiconductor wafer. For example, Collins, et al. explains that heating the reactor ceiling to a high temperature results in more polymer deposits on passivated surfaces of the wafer or workpiece (rather than on the ceiling). (Col. 4, lines 29-41). Additionally, a "temperature control apparatus" is described as including radiant heaters and a water-cooled cold plate for stably controlling the temperature of the ceiling 52 of the reactor. (Col. 8, line 64 – col. 9, line 34; col. 9, lines 42-67). Further, in one embodiment of Collins, et al., a ceiling temperature controller 218 works in conjunction with lamp power source 220 and heater lamps 72' to heat ceiling 52 to a desired temperature. (Col. 15, lines 17-45). And Collins, et al. describes using radiant lamps to heat silicon ring 62, a disposable silicon member that contributes silicon material during the plasma process. (Col. 14, line 62 – col. 15, line 11).

However, as stated above, nowhere does Collins, et al. disclose using a gas (during a stage of a predetermined heat cycle) to selectively control the temperature of at least one localized region of a semiconductor wafer to minimize temperature deviation of the region(s) from a predetermined temperature as required by independent claims 1 and 48. Thus, Applicants respectfully submit that claims 1 and 48 are not anticipated by the disclosure of Collins, et al.

Independent claims 46 and 49 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Collins, et al. in view of U.S. Patent No. 5,997,175 to Champetier, et al. The Office Action states that Collins, et al. does not teach the supplying of a gas by a reflective device located below the semiconductor wafer. In accordance with the above discussion, Applicants respectfully submit that Collins, et al. does not disclose, for example, the limitation in claims 46 and 49 requiring that a gas be provided to selectively control the temperature of at least one localized region of the semiconductor

wafer to minimize temperature deviation of the region(s) from a predetermined temperature.

The Office Action relies on Champetier, et al. as teaching the use of a reflective device located below the semiconductor wafer. Applicants respectfully submit, however, that as set forth in detail in a previous Response filed on May 30, 2002 for this application, the Champetier, et al. patent is not available as prior art to the present application. Further, even if certain aspects of Champetier, et al. are considered by the Patent Office to be prior art to the claims of the present application, combining the disclosure of Champetier, et al. with Collins, et al. does not cure the above-described deficiencies of Collins, et al. Champetier, et al. is generally directed to an apparatus for measuring the temperature of a semi-transparent radiating body. For example, the apparatus can include a first reflective device and a second reflective device that are contained within a chamber and positioned such that a radiating body can be placed between both. (Col. 4, lines 42-49). The first and second reflective devices include areas of high reflectivity, which reflect thermal radiation at a selected wavelength that is being emitted by the radiating body. (Col. 4, lines 45-48).

However, Champetier, et al. does not describe providing a gas to selectively control the temperature of at least one of a plurality of localized regions of a semiconductor wafer to minimize temperature deviation from a predetermined temperature. As shown in Fig. 1 of Champetier, et al., for instance, a chamber 12 is provided that includes a gas inlet 18 and a gas outlet 20 for introducing a gas into the chamber and/or for maintaining the chamber within a preset pressure range. (Col 7, lines 34-40). However, Applicants note that the gas inlet 18 and gas outlet 20 do not provide selective control over the temperature of a *localized* region. Instead, gas inlet 18 and gas outlet 20 simply provide a gas to the entire chamber, and not selectively to any particular region of the semiconductor wafer. In short, Applicants respectfully submit that independent claims 46 and 49 patentably define over Collins, et al. and Champetier, et al., alone or in any proper combination.

Additionally, claims 4, 6-7, 12-13, and 50-63 (which include independent claim 50) were rejected under 35 U.S.C. § 103(a) as being unpatentable over Collins, et al., in

view of U.S. Patent No. 6,506,691 to Cook, et al., U.S. Patent No. 6,387,182 to Horie, et al., and U.S. Patent No. 6,100,506 to Colelli, Jr., et al. With regard to independent claim 50, the Office Action relies on teachings from Cook, et al. as disclosing the claimed cooling stage. Applicants reiterate the above discussion and respectfully submit that Collins, et al. does not disclose or suggest certain limitations of claim 50, for example, providing a gas to selectively control the temperature of at least one localized region of the semiconductor wafer to minimize temperature deviation. The silicon nitride deposition method described by Cook, et al. does not cure such deficiencies.

Cook, et al. is generally directed to a method for rapid deposition of a silicon nitride film wherein the CVD reactor is operated to optimize the rate and uniformity of the deposition of silicon nitride. (Col. 2, lines 62-67). Although Cook, et al. describes both a cooling apparatus that cools the walls of its deposition chamber (claim 1) and water-cooling the gas nozzles that inject the process gas into its deposition chamber (col. 6, lines 10-12), Cook, et al. does not disclose or suggest the method of claim 50, which includes, *inter alia*, a cooling stage during which a gas is provided to selectively control the temperature of localized region(s) of a semiconductor wafer to minimize temperature deviation from a predetermined temperature. Thus, Applicants respectfully submit that independent claim 50 patentably defines over Collins, et al. and Cook, et al., alone or in any proper combination.

Various dependent claims were also rejected as being unpatentable over the references discussed in detail above. Applicant respectfully submits, however, that at least for the reasons indicated above relating to corresponding independent claims 1, 46, and 48-50, the dependent claims patentably define over the references cited in the Office Action. However, Applicant also notes that the patentability of the dependent claims does not necessarily hinge on the patentability of independent claims 1, 46, and 48-50. In particular, it is believed that some or all of the dependent claims may possess features that are independently patentable, regardless of the patentability of claims 1, 46, and 48-50.

In summary, it is respectfully submitted that the claims are patentably distinct over the prior art of record. Thus, it is submitted that the present application is in complete condition for allowance and favorable action, therefore, is respectfully requested. Examiner Lee is invited and encouraged to telephone the undersigned at her convenience should any issues remain after consideration of the present response.

Please charge any additional fees required by this Amendment to Deposit Account No. 04-1403.

Respectfully submitted,

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